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TROPICAL DISEASES AND HEALTH IN THE UNITED STATES

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Introduction.—Many of the problems that demand solution at the hands of the sociologist concern the parasites that infest the body politic, impairing its efficiency. The physician, on the other hand, particularly he who is engaged in the solution of the problems of sanitation, is concerned to a very large extent with the study of the parasites that infest the physical body, producing sickness and death.

Since the development of modern bacteriology, which saw its beginning in about 1870, the knowledge of the causes of the acute infectious diseases of man has had an interesting and rapid evolution. Following naturally the discovery of the exciting causes of various diseases, the methods of preventing the development of those maladies were rapidly worked out. But it was soon found that some affections that acted like other acute infectious diseases of known etiology could not be associated with a discoverable bacterium in the relation of cause and effect. The discovery by Laveran, in 1880, of the *Plasmodium malariae* and the demonstration of its animal characteristics led to fresh investigations. These studies, in turn, showed that some of the acute infections were due to animal parasites. The understanding of the life history of these organisms, however, has proved to be a much more complicated matter than the description of the biological characters of the vegetable parasites.

It has been found that many of the animal parasites of which man is the host cannot be transmitted from one individual directly to another. The parasitic organism requires a developmental period in an intermediate host before it can be inoculated into another individual there to develop and produce disease. The parasitic form which infects the intermediate host is usually different in

morphology from that which produces the disease in man. The intermediate hosts are usually insects or some other animal low in the zoological scale. These low animal forms require warmth, moisture, and oxygen for their development. These three requisites are also necessary for the development of the parasites themselves, as well as for the growth of the vegetable parasites, bacteria, that produce disease.

All of the lower forms of life, whether animal or vegetable, flourish best in warm, moist climates, so that we find some regions of the earth more unhealthy than other regions, on account of the greater amount of moisture and heat with the resulting profuse growth of the lowest forms of life. In addition to heat and moisture, the lower forms of life require a certain amount of food in the nature of decomposing animal and vegetable material. This is found in abundance in hot, moist climates, particularly when no effort is made to prevent the accumulation of such decomposing masses. Furthermore, a hot, moist climate is debilitating to the human organism, so that initiative and energy are lacking and a disposition is developed to let things go as nature apparently means that they shall go: the spirit to improve conditions is lacking. Consequently, we observe the establishment of a vicious circle; the native is lacking in energy; he permits masses of decomposing animal and vegetable matter to accumulate in the vicinity of his dwelling; this breeds the lower forms of life which are able to develop the parasites that produce disease; these parasites infect the dweller in their neighborhood. Those inhabitants that escape death are still further reduced in vitality and their efficiency is still further impaired. Furthermore, they are carriers of disease-producing parasites which increase in number, until finally, the neighborhood acquires an unenviable reputation as a pest hole.

Climate.—The climates of the world are divided by Dr. C. Hart Merriam (National Geographic Magazine, 1894, Vol. VI) into the Tropical Zone, the Lower Austral Zone, the Upper Austral Zone, the Transitional Zone, and the Boreal Zone, according to the total amount of heat present during the year. In the Tropical Zone there is 26,000° F. of heat during a year, the hottest period showing a maximum temperature of 78.8° or over. In the Lower Austral Zone the total heat amounts to 18,000° F. with the hottest period above 78.8°. In the Upper Austral Zone the total heat is 11,500° F.,

with the hottest period below 78.8° F. In the Transitional Zone the total heat is $10,000^{\circ}$ F., with the hottest period below 71.6° F. In the Boreal Zone the total heat for the year is below $10,000^{\circ}$ F. and the hottest period is below 64.4° F.

The Tropical Zone extends from the Tropic of Cancer, $23^{\circ} 30'$ north of the equator, to the Tropic of Capricorn, $23^{\circ} 30'$ south of the equator. But north of the Tropic of Cancer and south of the Tropic of Capricorn there is a belt, the Lower Austral Zone, in which for a considerable part of the year the climatic conditions are similar to those in the Tropical Zone. In the United States, this zone includes all of the Southern and Western states below the thirty-fifth parallel of north latitude: South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, and parts of North Carolina, Arkansas, Indian Territory, Oklahoma, New Mexico, Arizona, and California. It is even probable that this line could be pushed as far north as the fortieth parallel. In 1909, for example, Philadelphia had a total amount of heat of $20,153^{\circ}$ F., this is over $18,000^{\circ}$ F. During the hottest period the thermometer registered above 78.8° F. Even subtracting the 558 degrees excess temperature over the normal temperature for Philadelphia in 1909 the total heat would be 19,593 degrees, enough to include Philadelphia, which is $39^{\circ} 57'$ north latitude, in the Lower Austral Zone. In 1910 the total amount of heat was $19,861^{\circ}$ F., with the hottest period above 78.8° F. Similar studies would show that many places in the United States possess the necessary amount of temperature for their inclusion in this zone.

Requisites for the Development of a Disease from the Tropics. In order, however, that any disease shall develop in a given region of the world, three essentials, in addition to a proper climatic condition, must be present: the cause of the disease, the proper transmitting agent, and susceptible individuals. Climatic features may be suitable, the cause of the disease may be present, susceptible individuals may reside in the district; but if the transmitting agent is absent the disease will not develop. If now the transmitting agent is suddenly introduced into that locality an epidemic of the disease will result.

On the other hand, the transmitting agent may be present and susceptible individuals may reside in a locality; but if individuals harboring the parasites be not present, the disease will not be

found. If now human hosts of the parasite come to the region in question bringing the parasites with them an epidemic will follow.

Relations of the United States with the Tropics.—The Anglo-Saxon race has had intimate relations with the tropics for over three hundred years. In 1579 Thomas Stevens sailed from Lisbon to Goa in India. So far as is known he was the first Englishman to visit that great empire. In 1583 three London merchants started overland for India. This enterprise was followed by the endeavor of three ships to make the journey around the Cape of Good Hope in 1591. The fabulous wealth reported to be in existence led to the formation of the British East India Company, which was chartered in 1600, and sent out its first expedition in 1601. Ever since then England has had intimate relations with the tropics and has known at first hand of the ravages of its diseases. That part of the Anglo-Saxon race which resides in the Western Hemisphere has had a merely casual acquaintance with the tropics until the occurrence of the Spanish-American War, in 1898. The acquisition of the Philippine Islands, Puerto Rico, and Guam, followed by our intimate relations with Cuba and the undertaking of the Panama Canal has brought the problems of tropical pathology and tropical hygiene strongly to our attention. We suddenly realize that many of our home ports are within the limits of the Lower Austral Zone: Galveston, 28° 18' N.; New Orleans, 29° 57' N.; Mobile, 30° 45' N.; Jacksonville, 30° 45' N.; Savannah, 32° 4' N., and that the United States-Mexican border extends for a varying distance north and south of the thirtieth parallel of north latitude. We then find that other of our ports have a total degree of heat that would be suitable, for a portion of the year at least, for the development of diseases supposed to be peculiar to the tropics, provided all the essentials were present.

We find 424,313 immigrants landing on our shores from tropical and subtropical countries in 1907, and 224,930 immigrants from the same regions in 1908. Our soldiers, our sailors, our missionaries and our business men are visiting the tropics in greater numbers with the advancing years. We further find that at home we have had for many years a disease common in the tropics, uncinariasis, or hookworm disease, probably imported from Africa with slaves. Tropical medicine, consequently, is a matter of intimate concern to the health authorities of our country, and not a mere academic

question. The immigrant and the homecoming citizen are important enough to require consideration in this respect, if we had never had an epidemic of yellow fever, of plague, or of cholera in our home territory. The prevention of an epidemic of imported disease, however, is a comparatively easy matter when the cause is known, and, at the hands of the United States Public Health and Marine-Hospital Service the introduction of epidemics has been and will be prevented so far as foreknowledge, foresight, and jurisdiction can accomplish the result.

The Essential Feature of the Prevention of Tropical Disease.

—The one essential feature of prevention of tropical diseases is the cleanliness of our seaports, the cleanliness of our inhabitants, the cleanliness of our houses. By cleanliness is meant the drainage of mosquito breeding marshes and streams, the prevention of the development of flies, and the destruction of rats and mice, as well as the washing of bodies, the fumigation of houses and vessels, the sweeping of streets, the proper disposition of sewage and garbage, and the inspection of food products.

The Tropical Diseases.—The following list of disorders may be looked upon as including the diseases indigenous to tropical and subtropical countries which can be transmitted to temperate climates, upper austral and transitional, provided the requisite conditions of heat, moisture, intermediate hosts, parasites, and susceptible population are present in the given locality.

A. Disease due to protozoan (one-celled) parasites:

1, malaria; 2, hemoglobinuric fever; 3, amebiasis; 4, trypanosomiasis; 5, kala azar; 6, spirochetosis: (a), relapsing fever; (b), Rocky Mountain fever; (c), tabardillo.

B. Diseases due to metazoan (many-celled) parasites:

1, trematode infection; 2, cestode infection; 3 nematode infection.

C. Diseases due to bacteria:

1, plague; 2, cholera; 3, dysentery; 4, Malta fever; 5, leprosy.

D. Diseases of unknown etiology:

1, yellow fever; 2, dengue; 3, beriberi; 4, pellagra.

Malaria is a disease indigenous to the tropics and to subtropical countries. It is caused by a genus of protozoan parasites, known as *Plasmodium*, of which there are at least three, and, according to some writers, more species. The parasite is known to undergo a cycle of development within its human host, which perpetuates the disease in the individual. While the various steps in this cycle are taking place regularly, a second form of development of the parasite takes place, which results in the production of forms that produce no symptoms in the human host; but which are capable of infecting the intermediate host. The intermediate host of the *Plasmodium* is the female mosquito of the subfamily *Anophelinæ*. Not all species of anopheles mosquitoes can become infected from the human host, but at least seven have been shown by actual experiment to be the efficient agents for the transmission of the disease. Manson, however, gives a list of thirty-two species from various parts of the world which are known or suspected to be efficient hosts of the *Plasmodium*. After the parasite has passed through its developmental stage in the body of the mosquito, forms result that can be inoculated into a susceptible human subject by the bite of the insect, and so the disease is spread. No other method of transmission from man to man is known.

Mosquitoes always breed in water. Some species prefer clean, slowly running water; others prefer stagnant water; still others breed in collections of water in artificial containers. The members of the subfamily *Anophelinæ* prefer, as a rule, the clean, slowly running water found at the edges of streams and in marshes in which there is some current.

The amount of sickness due to malaria in a malarial country is incalculable. Woldert (*Texas Medical News*, April, 1908) estimates that malaria causes the loss of an equivalent of over five million dollars a year in the State of Texas alone. The most efficient way to prevent the sickness and death due to this disease is the destruction of the breeding places of the intermediate host of the parasite. Marshes should be drained or filled in. Streams should be cleaned of the growth of grasses, flags, and sedges which are found near the banks, delaying the currents, and providing by their interlacing roots safe retreats for the mosquito larvæ from their natural enemies. Artificial collections of water should be destroyed or efficiently screened so that the adult female cannot

gain access to them for the purpose of depositing her eggs. All money spent by the state in this work is well invested. The return is seen in the increased efficiency of the individual, in the lowered death rate and sick rate, and, in the case of drained marshes, in the increase in the area of arable land.

A district in which there is no malaria may owe its freedom to the absence of the proper malaria carrying mosquito, to the absence of individuals harboring that form of the malarial parasite in their blood which can infect the mosquito, or to both. If the proper mosquitoes exist in a given neighborhood, but no infected individuals are present, no malaria will be found; but if human hosts, apparently in perfect health, with the suitable form of the malarial parasite in the blood are brought to the region, an epidemic of malaria will result. For example, if a rural district contains swamps or choked streams in which anopheles mosquitoes are breeding, and a gang of Italian or West Indian laborers, many of whom harbor malarial parasites, are imported for the purpose of some public work such as road building or canal excavating, an epidemic of malaria will follow.

On the other hand, a malarial district may be rendered almost nonmalarial by destroying the breeding places of the mosquitoes. The active work of the Department of Sanitation of the Isthmian Canal Commission in searching for and destroying the breeding places of mosquitoes in the Canal Zone, and screening the quarters of the employees, has resulted in the reduction of the morbidity from malaria from 821 per 1,000, in 1906, to 282 per 1,000 in 1908, and 215 per 1,000 in 1909. The mortality was reduced from 8.77 per 1,000 in 1906, to 1.34 per 1,000 in 1908, and 1.10 per 1,000 in 1909. This result can be paralleled in any American community by similar methods with a relatively small outlay of money.

The Italian method of furnishing quinine to the inhabitants for prophylactic purposes is not nearly so efficient; nor is a method which relies on screening the dwellings of the inhabitants without a campaign for the destruction of the mosquitoes and their breeding places.

Hemoglobinuric fever, or blackwater fever, is believed by many writers to be dependent upon previous malaria. If this be so, the control of the latter will be attended by the disappearance of the former disease. There are students of tropical problems,

however, who believe that hemoglobinuric fever is an independent disease. If this be true it should be placed among the diseases of unknown etiology. Hemoglobinuric fever is present in the Philippine Islands, in the West Indies, in Central and South America, in the Canal Zone, in Texas, and in Arkansas, and probably in other parts of the lower austral zone of the United States. So far as we know at present its deleterious influence upon the public health is not great and no alarm need be felt for an extensive propagation of cases.

Amebiasis is a disease due to a protozoan parasite, *Entameba histolytica*, which attacks the large intestine of man and of the lower animals. The infection manifests itself by attacks of dysentery, and in many of the cases, as high as 33 per cent in some instances, it is followed by abscess of the liver. The parasite is apparently transmitted from man to man by potable water. It is possible that it may be transmitted by green vegetables, in localities where human feces is used as a fertilizer, as is the custom in China and other Eastern countries. Its spread may be stopped by boiling the drinking water, by the prohibition of the use of human excrement as a fertilizer, and by the prohibition of indiscriminate defecation into streams or other sources of water supply for towns, villages, or isolated farm houses.

Amebiasis is prevalent in the Canal Zone, certain of the West India Islands, some of the Southern states, for example, Louisiana, Puerto Rico, and the Philippine Islands. Individuals with intestinal trouble returning from these countries should be carefully studied for the detection of these parasites.

Trypanosomiasis is a disease due to a protozoan parasite, *Trypanosoma gambiense*. It is at first a febrile complaint which bears some resemblance in its clinical manifestations to malaria; but in its last stages it is accompanied by a marked degree of lethargy and is commonly known as sleeping sickness. The parasite is transmitted from man to man by a dipterous insect; the Tsetse fly, *Glossina palpalis*. The disease is confined to the valley of the Congo River, the shores of Victoria Nyanza, and other parts of tropical Africa. So far as is known *Glossina palpalis* does not breed on the American Continent, consequently no harm is to be apprehended from this disease in the United States, even if an infected individual should land upon our shores. If *Glossina pal-*

palis can be bred in our own lower austral region, the United States Public Health and Marine-Hospital Service will have to institute active fumigation measures on all ships coming from African ports to our Gulf and South Atlantic ports to prevent the domestication of the fly.

Kala Azar is a disease due to a protozoan parasite, *Leishmania Donovanii*. It is found in Assam, Madras and Bengal. The method of transmission of the parasite is not known, and no danger is to be apprehended from this disease. Dr. S. T. Darling, however, has observed a few cases in the Canal Zone similar to Kala Azar, and has found a parasite of similar appearance in the organs of the patients at necropsy. This parasite has been called *Histoplasma capsulatum*. The possibility of serious danger to the public health from such a source is remote.

The best known example of spirochetosis is the European relapsing fever, due to an organism known as *Spirocheta recurrentis*. A few imported cases have been seen in this country and small epidemics have been recorded in New York and in Philadelphia in past years. The parasite is supposed to be transmitted by the bed-bug or the body louse. No extensive epidemic of this disease has been observed in this country and its further prevention will be accomplished by isolating imported cases and by the disinfection of the belongings of the patients for the destruction of any vermin that they may harbor.

In the Bitter Root Valley of Wyoming, and in some other parts of our Rocky Mountain region there is an epidemic disease, known as Rocky Mountain fever, which is known to be transmitted by the bites of certain ticks, *Dermacentor occidentalis*. It is probable that this is a spirochetosis.

The disease endemic in Mexico known as tabardillo, which caused the death of the investigator who proved the transmission of Rocky Mountain fever by the bites of infected ticks, Dr. H. T. Ricketts, is in all probability of the same nature. The public health authorities of the states forming the United States-Mexican border, Texas, Arizona, New Mexico and California, will have to meet the problem of the prevention of the importation of this infection into our domain with the increased communication across the border.

The disease caused by metazoan parasites are, as a rule, intes-

tinal disturbances due to the presence of the parasites in the alimentary tract. There are one or two exceptions to this rule, notably the disease known as schistosomiasis, in which the parasites and their eggs are found in the blood vessels of the gastro-intestinal canal or of the genito-urinary organs, and the disease known as filariasis, in which the parasites are found in the lymphodes or the connective tissue in the various parts of the body. In filariasis the embryos are found in the circulating blood.

Many of these parasites gain entrance to the human body with food or drink, others require development up to a certain stage in intermediary hosts, still others gain entrance to the human body through the skin. Much work remains to be done on the life histories of many of these animals before definite knowledge of the manner of infection is to be had.

The trematodes are low forms of the natural order Vermes. With one exception they are hermaphroditic organisms which infect the various parts of the gastro-intestinal tract. One variety, which is indigenous to the Philippine Islands and other far Eastern countries, is found in the lungs. The parasites are not known to be indigenous to any part of the United States although it is not beyond the range of possibility that they may be represented in our home territory. However, climatic conditions are such in our lower austral zone that, provided suitable intermediary hosts are present, they may become established in this country. So far as we know, cleanliness in personal habits, care in the preparation of food, and abstention from eating uncooked fruit and vegetables are all that is necessary to prevent the spread of such infections.

Schistosomiasis is the disease produced by a trematode parasite, in which the male and female generative organs are contained in separate bodies. The disease is also known as bilharziasis. It is common in Egypt and in some other parts of Africa, and in Asia. A form of the disease has been met with in the West Indies and in some parts of Central and South America. The symptoms depend upon the location of the parasites and their ova. Sometimes an inflammation of the bladder results; in other cases the symptoms resemble those of dysentery. A variety of this infection is met with in China and Japan, one case of which has been imported into this country.

The cestodes are the tapeworms. Infection with these parasites

is by no means confined to the tropics or to subtropical countries; but in both these regions cestode infection is more common than in temperate climates. Nearly all of these parasites depend for their development in man upon the eating of insufficiently cooked meat. The inspection of our abattoirs by the officials of the United States Department of Agriculture prevents the marketing of infected meat, and is a public health measure of the first order. The proper cooking of meat is further responsible for the rarity of the occurrence of these worms in Americans.

The nematodes are the round worms. Infection with one of these is fairly common even among the children of the better class. Infection with the hookworm, *Necator americanus*, has been shown within the past ten years to be very common in the Southern states. Trichiniasis, infection with *Trichina spiralis*, is seen in rare cases. Filarial infections have been reported in our home territory. Prevention of these infections varies with the individual parasite.

Ascaris lumbricoides infection is to be prevented by teaching children to be careful of the things which they put into their mouths. We do not know the life history of this parasite, but infection appears to be the result of taking the embryos or the ova into the digestive tract.

Hookworm disease, uncinariasis, is a serious problem in our Southern states. The embryos develop in moist, sandy soil, and gain entrance to the body through the skin. The wet sand adheres to the skin of the legs and feet, and the embryos burrow into the underlying tissues and finally reach the intestine by a circuitous route. The disease has long been known in Egypt and other parts of the tropics of the Eastern Hemisphere as *anchylostomiasis*. It was a serious public health problem during the construction of the St. Gothard Tunnel, in 1880. Our army medical men found it in Puerto Rico, and subsequently the parasites were discovered in the South. Its presence results in a severe anemia which may be fatal. The prevention of the extension of the disease can be accomplished by the prohibition of soil pollution and by educating the people to wear shoes. In many localities the inhabitants are too poor to buy shoes. In such circumstances prevention of indiscriminate soil pollution is first in order. The amelioration of poverty, on the other hand, so that each individual can obtain enough

compensation for his work to be able to buy shoes for his family is a question for the political economist and the tariff commission.

It has been found in Puerto Rico that in cases of certain ladies of the better class who harbored *Necator americanus*, the infection had occurred through the skin of the hands from working in flower gardens, the soil of which had been fertilized by human feces. It has also been suggested that uncinariasis was one of the causes of the high morbidity and mortality among the Union prisoners in Confederate prisons from 1861 to 1865, particularly in Andersonville.

The Rockefeller commission will undoubtedly succeed in banishing this infection from our Southern States. It must, however, prosecute a long campaign of education before it can improve the sanitary conditions in the rural districts and inculcate new habits of personal hygiene in the inhabitants.

In filariasis the adult parasite inhabits the lymphnodes and the connective tissues. The embryos circulate in the peripheral blood. The presence of these parasites excites a train of diseases, the best known of which is elephantiasis. The disease is present in certain of the West India Islands. The embryos are taken into the stomach of a female mosquito and undergo a metamorphosis in the thoracic muscle of the insect. After the change in the embryos is completed, they migrate to the proboscis of the mosquito and are inoculated into the new individual by the bite of the insect.

Whatever of danger there may be in the importation of filariasis into the United States is to be obviated by a mosquito campaign. In this infection the intermediate host is not only the mosquito of the subfamily Anophelinæ but also certain species of the subfamily Culicinæ. The culex mosquito will breed in any kind of water, some species developing in almost pure filth. Consequently, it is not only necessary to drain marshes and to clean out streams, but also to dispose of all collections of still or stagnant water; the water in flowerpots in cemeteries, in discarded tin cans, in broken bottles, drains, cisterns, etc., has been found swarming with culex larvæ. The collections of water in the hollow branches and the trunks of trees, and in the corollas of many plants, such as the pitcher plant, have been found to be breeding places for these insects. There is no danger of the direct transmission of filarial infection from man to man.

Of the diseases due to bacteria, plague is the one of most

interest to the American health officer. The disease is due to an organism known as *Bacillus pestis*. Through the work of the English Plague Commission, done in Bombay and its environs, it has been definitely established that the disease is originally one of rats and mice and that it is carried from rat to rat by the bites of infected fleas. After the rat population of a city has been reduced by the epizootic, the fleas, no longer finding sufficient animal food, turn their endeavors to and become temporary ectoparasites of man. The epidemic then spreads from man to man by the bites of infected fleas. In a few cases, about one per cent in a large epidemic, the disease exists in man as a pneumonia excited by the *Bacillus pestis*, and this form of the infection is transmissible from man to man directly by infected sputum, which is disseminated by coughing, and by soiled bed linen and personal linen.

In the prevention of an epidemic of plague, the destruction of rats and mice, is the important sanitary problem. The isolated patient is not dangerous provided he is not suffering from the pneumonic form of the disease. Plague has been present in San Francisco twice within the past ten years. In 1900 the business men and health officials of San Francisco and California made a serious blunder in denying the existence of the disease, and, by their attitude, causing the resignation of an officer of the United States Public Health and Marine-Hospital Service who was eminently equipped for coping with the situation. As a result, the disease ran for a period of two or three years with occasional cases reported, and the rat population of San Francisco became generally infected so that in 1907 plague again appeared in that city. This time, however, profiting by the former error, the health authorities of California and of San Francisco summoned the federal authorities to their aid and, by placing the matter entirely in the hands of the latter, had the satisfaction of seeing the epidemic stopped in eight months with a total of 160 cases and 78 deaths. Fifteen cases occurred in Oakland and Seattle with 10 deaths. During this period the Public Health and Marine-Hospital men were killing 10,000 rats a week, about three per cent of which were found infected with *Bacillus pestis*. The officers in charge of the work further developed the fact that the wood squirrels about Oakland were infected with plague, and measures have been taken to destroy these rodents.

The destruction of rats in our seaports is a problem that should at once receive attention from the proper sanitary authorities. A ship coming from a plague port with infected rats in its hold should be so moored that these animals cannot get ashore. For this purpose rat guards have been devised for the purpose of preventing the rodents from leaving the vessel at night by way of the hawsers, and starting an epizootic among the rats on land. Once started in New York or Philadelphia these cities would pass through an experience similar to that of San Francisco. The rat population is ready to hand, the rat flea is ready with his host, and the climatic conditions from May to October are suitable.

No advantage except a temporary one, is ever gained by denying the existence of an epidemic in any city. The hiding of the facts gives a chance for the disease to gain headway and to result finally in a greater loss to business and a more appalling loss of life than though the disease were admitted to exist from the beginning and proper prophylactic measures immediately instituted.

Cholera is due to the *Bacillus cholerae*. It is a water-borne disease, the infected individual polluting the water supply by improper disposition of his feces. Flies are sometimes responsible for epidemics by first alighting on objects contaminated with the bacilli and then alighting upon exposed food stuffs. It is hardly to be conceived that an epidemic of this disease should start in any of our American cities. The quarantine officers are constantly on the lookout for cases of intestinal disturbance in immigrants from parts in which cholera exists, as well as in the members of the crews of the vessels.

In Mohammedan countries many pilgrims returning from Mecca bring holy water with them from the Holy City. In order to give all the faithful an opportunity to benefit from the water, the contents of the bottle are emptied into the well or other source of water supply of the village to which the pilgrim belongs. Since the holy water frequently contains cholera bacilli, an epidemic results. With the increasing Mohammedan population of the Pacific coast this is a problem that may confront our health officers in the future. Infection of the individual is to be prevented by boiling the drinking water, by abstaining from the use of uncooked foods, and by care in the production of the milk supply. The house fly should not be neglected. The patient is not dan-

gerous provided his intestinal and other discharges are properly sterilized before being consigned to the cesspool or sewer. Burning is the most efficacious method of disposing of infected human feces.

Dysentery, except the amebic form, already referred to under the head of amebiasis, is due to *Bacillus dysenteriae*. The epidemics are of minor import, so far as they have occurred in our own land. In the tropics and in subtropical countries, where the climate is depressing and where the poorer classes are more constantly underfed and overworked than with us, the disease often assumes serious proportions. It is water-borne and requires the same preventive measures that apply to cholera. The fly problem is important in its relation to this infection.

Malta fever is caused by the *Micrococcus melitensis*. Cases of the disease are found in the Mediterranean littoral in greatest numbers. Cases have been found in Cuba and Puerto Rico, Central and South America, and it is not beyond the range of possibility that cases occur along the United States shores of the Gulf of Mexico. In Malta, the disease is supposed to be transmitted by drinking the milk of infected goats; these animals supplying the milk for the inhabitants of the island. The disease is not very severe and the death rate is small, about three per cent. It is responsible, however, for a large amount of invalidism. The problems to be solved in case it should ever be found in our country are entirely hypothetical.

The attitude of the public toward leprosy is a blot upon our civilization. The disease is caused by the *Bacillus lepræ*. It is not, strictly speaking, a tropical disease, Norway and Iceland being countries in which it is indigenous. It is transmitted only by very intimate personal contact. The patient is not a danger to the community in which he dwells, unless it be proved that the suspicion, now entertained, that the organism is transmitted by the bites of infected bedbugs is warranted. Even then cleanliness is the answer to the public health question involved. The segregation of lepers in colonies is advisable on account of the repulsive nature of the deformities seen in the advanced cases; but not because there is any fear of an epidemic.

Leprosy is endemic in many Central and South American States. There is a leper colony in Louisiana. It is common in

the Hawaiian Islands, in China, in Japan, and in the Philippine Islands. The treatment of the unfortunate victim of this disease who was discovered in a village in Maryland about two years ago is shameful, productive of no good to the general public, and an insult to twentieth century knowledge.

Of the diseases of unknown etiology, yellow fever has been our most serious tropical problem. The disease is endemic in Cuba and in Brazil and has frequently been seen in epidemic outbreaks in our Southern states and in Central and South America. Some cases have been seen on the west coast of Africa, and epidemics have occurred in the past in Philadelphia, New York, and Baltimore.

The work of the Yellow Fever Commission of the United States Army in Havana, in 1900, has proved that the disease is transmitted by the bite of infected *Stegomyia calopus* mosquitoes. The problem of prevention of epidemics, therefore, resolves itself into the destruction of *Stegomyia calopus*. This was successfully demonstrated in New Orleans in 1908. *Stegomyia calopus* apparently always breeds in artificial collections of fairly clean water. Consequently the screening of cisterns, wells and reservoirs is absolutely necessary. The patient must be treated in a ward or an apartment screened from the access of mosquitoes, and the apartment from which he was removed at the onset of the disease must be fumigated for the purpose of killing what adult mosquitoes may be contained in it; but for no other reason. The patient is harmless, except he is bitten during the first three or four days of his illness.

The American people owe a debt of gratitude to Dr. James Carroll, Dr. Walter Reed, Dr. Jesse Lazear, and Dr. Aristides Agramonte which pensions and monuments can but partially repay. It is a parsimonious congress indeed that will neglect the widows of Dr. Carroll and Dr. Reed while it corrects the military records of patriotic deserters.

Dengue is frequently met with in epidemic form in the Southern United States and in the West Indies. It is a considerable factor in morbidity statistics in the Philippine Islands. It is met with in many tropical and subtropical countries. It is not dangerous to life, the death rate being less than one per cent, and the fatal cases being seen in individuals who were already suffering from some chronic complaint when attacked by dengue. Our knowledge of

the transmission of dengue is due to the work of the United States Army Board for the study of tropical diseases as they occur in the Philippine Islands, Dr. P. M. Ashburn and Dr. Charles F. Craig. These investigators, following the methods pursued by the Yellow Fever Commission in Cuba, have demonstrated the transmission of the disease by the mosquito *Culex fatigans*. The prevention of epidemics of dengue is a question of mosquito extermination.

Beriberi is a disease indigenous to China, Japan, the Philippine Islands, the Malay Peninsula, and India. It is characterized by an acute febrile period, followed by dropsy, and later, by paralysis. The cause of the disease is unknown. The majority of students of tropical pathology are of the opinion that it is the result of the consumption of spoiled rice. Some few observers believe it to be dependent upon an unknown parasite.

The presence of a case of beriberi upon a vessel from an Indian, a Chinese, or a Japanese port is no excuse for scareheads in the newspapers. It is perfectly safe to treat such a patient in the general wards of a New York hospital.

Conclusion.—It is no part of the intention of the writer of this paper to increase the causes of uneasiness of certain susceptible individuals among his countrymen. The knowledge that certain diseases exist, that they have well known causes, that they are disseminated by well understood agents, and that their spread can be prevented by well tried methods, should make for peace of mind rather than for worry. A man who is on his way home at night will not fall into the ditch, provided he knows where the ditch is. The knowledge of the existence of an epidemic disease is the most important element of the campaign to eradicate the disorder.

The application of the various sanitary methods referred to in the course of this paper is of the first importance wherever men are gathered together. We are fairly well informed as to the value of a noncontaminated water supply, of a clean milk supply, of clean streets, of proper garbage and sewage disposition. All these things cost money, but we now know that the money is well spent. Campaigns of mosquito extermination, of fly destruction, of rat and mouse extirpation will be found to be investments that will pay.

In the Nobel Lecture at Harvard on December 14, 1910, ex-President Roosevelt said:

Many men have rendered high and honorable service to the United States in connection with the work of the Panama Canal, but by far the greatest and most important work has been rendered by Colonel Goethals. It is to him more than to any other one man that we owe the successful accomplishment of one of the great business and engineering feats of all the ages.

When it is completed, Colonel William C. Gorgas will have made possible "more than any other one man" the construction of the Panama Canal. The Canal would have been a French achievement, had it not been for yellow fever and malaria. Whatever of dishonesty in affairs may have existed in the French company was of small import beside these two tropical diseases. Shoulder straps have never prevented the bite of a malaria carrier, nor of a yellow fever carrier.

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